PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04L 29/08, H04Q 7/22

A1

(11) International Publication Number: **WO 00/51312**

(43) International Publication Date: 31 August 2000 (31.08.00)

(21) International Application Number: PCT/US00/04931

(22) International Filing Date: 24 February 2000 (24.02.00)

(30) Priority Data:
09/256,118 24 February 1999 (24.02.99) US

(71) Applicant: QUALCOMM INCORPORATED [US/US]; 5775 Morehouse Drive, San Diego, CA 92121 (US).

(72) Inventors: LIOY, Marcello; 7588 Charmant Drive, #1924, San Diego, CA 92122 (US). ABROL, Mischal; 7260 Calle Cristobal, #41, San Diego, CA 92126 (US).

(74) Agents: WADSWORTH, Philip, R. et al.; Qualcomm Incorporated, 5775 Morehouse Drive, San Diego, CA 92121 (US).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

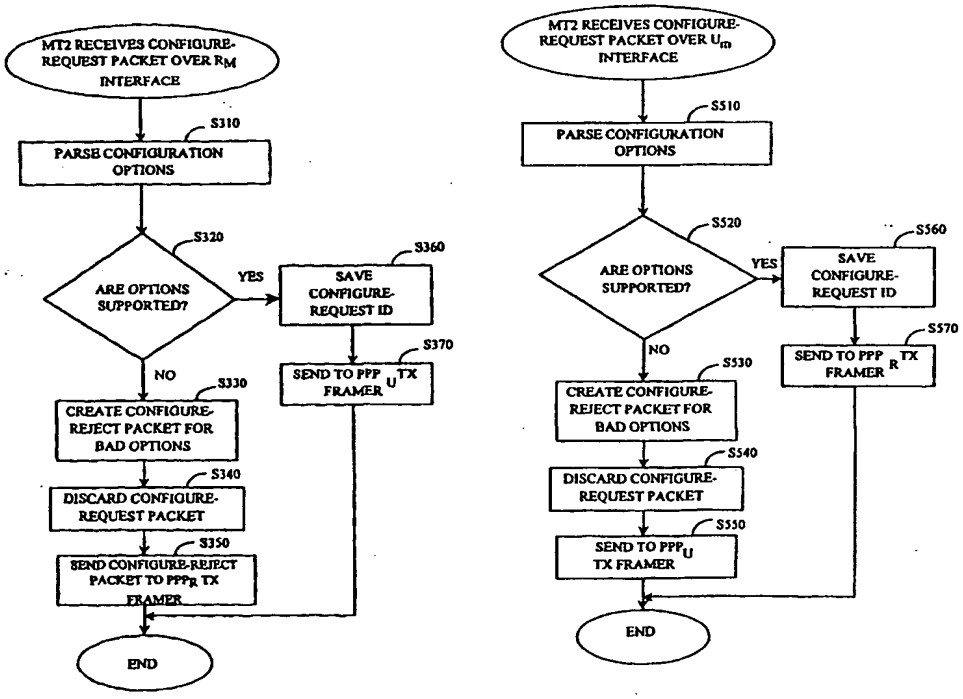
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SIMULTANEOUS SETUP OF PPP ON A UM AND RM INTERFACE

(57) Abstract

A method and a wireless communication device (MT2) (104) for simultaneously negotiating LCP or IPCP configuration options over both the R_m and the U_m interfaces. When the MT2 device (104) receives either an LCP or an IPCP Configure–Request packet over one of the R_m or the U_m interfaces, the MT2 device parses the requested configuration options (S310, S510) and determines whether the requested options are supported (S320, S320) by the MT2 device. If the requested options are supported, the MT2 device saves a Configure–Request ID (S360, S560), included in the Configure–Request packet, and frames the Configure–Request packet in a PPP frame for transmission on the other of the R_m or the U_m interfaces. If any of the requested configuration options are not supported by the MT2 device, the MT2 device creates a Configure–Reject packet (S330, S530), including the unsupported options, and frames the Configure–Reject packet in a PPP frame for transmission over the interface through which it received the Configure–Request packet.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

SIMULTANEOUS SETUP OF PPP ON A UM AND RM INTERFACE

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates to the field of wireless data services. More particularly, the present invention relates to a novel and improved method and system for setting up a Point-to-Point Protocol (PPP) link between a terminal equipment (TE2) and a base station/mobile switching center (BS/MSC) interworking function (IWC) through a wireless communication device (MT2).

II. Description of Related Art

Internetworking, i.e., the connection of individual local area networks (LANs), has rapidly become very popular. The infrastructure and associated protocols commonly referred to as the "Internet" have become well known and widely used. A well known protocol for providing access to the Internet is the Point-to-Point Protocol (PPP) which provides a standard method for transporting multi-protocol datagrams over point-to-point links, and is further described in Request for Comment (RFC) 1661, W. Simpson, Editor, dated July 1994, herein incorporated by reference.

PPP includes three main components:

1. a method of encapsulating multi-protocol datagrams;
2. a Link Control Protocol (LCP) for establishing, configuring, and testing a data link connection; and
3. a family of Network Control Protocols (NCPs) for establishing and configuring different network-layer protocols.

FIG. 1 illustrates a high-level block diagram of a wireless data communication system in which a mobile terminal (TE2 device) 102 communicates with an interworking function (IWF) 108 via a wireless communication system which includes a wireless communication device (MT2)

104 and Base Station/Mobile Switching Center (BS/MSC) 106. As used herein MT2 may refer to either a phone or a combination of a phone and a PCM CIA card. In FIG. 1, the IWF 108 serves as the access point to the Internet. IWF 108 is coupled to, and often co-located with BS/MSC 106, which may be a conventional wireless base station, as is known in the art. TE2 device 102 is coupled to MT2 device 104, which is in wireless communication with BS/MSC 106 and IWF 108.

Many protocols exist which allow data communication between the TE2 device 102 and the IWF 108. For example, Telecommunications Industry Association (TIA)/Electronics Industries Association (EIA) Interim Standard IS-707.5, entitled "Data Service Options for Wideband Spread Spectrum Systems: Packet Data Services," published February 1998, and herein incorporated by reference, defines requirements for support of packet data transmission capability on TIA/EIA IS-95 wideband spread spectrum systems, of which BS/MSC 106 and IWF 108 may be a part. IS-707.5 also provides the requirements for communication protocols on the links between the TE2 device 102 and the MT2 device 104 (the R_m interface), between the MT2 device 104 and the BS/MSC 106 (the U_m interface), and between the BS/MSC 106 and the IWF 108 (the L interface).

Referring now to FIG. 2, a diagram of the protocol stacks in each entity of the IS-707.5 Relay Model is shown. FIG. 2 corresponds roughly to Figure 1.4.2.2-1 of IS-707.5. At the far left of the figure is a protocol stack, shown in conventional vertical format, showing the protocol layers running on the TE2 device 102 (e.g., the mobile terminal, laptop or palmtop computer). The TE2 protocol stack is illustrated as being logically connected to the MT2 device 104 protocol stack over the R_m interface. The MT2 device 104, is illustrated as being logically connected to the BS/MSC 106 protocol stack over the U_m interface. The BS/MSC 106 protocol stack is, in turn, illustrated as being logically connected to the IWF 108 protocol stack over the L interface.

As an example of the operation of the protocols of Fig. 2, the Point to Point Protocol (PPP_R) protocol 206 encodes packets from the upper layer

protocols 202, 204 and transmits them across the R_m interface using the EIA-232 protocol 208 to the EIA-232-compatible port on the MT2 device running the EIA-232 protocol 210. The EIA-232 protocol 210 on the MT2 device, receives the packets and passes them to the PPP_R protocol 205. The PPP_R protocol 205 unframes the packets encapsulated in PPP frames and typically, when a data connection is up, passes the packets to PPP_U protocol 215, which frames the packets in PPP frames for transmission to a PPP peer located in the IWF (108). The Radio Link Protocol (RLP) 212 and IS-95 protocol 214, both of which are well known in the art, are used to transmit the packets, which are encapsulated in PPP frames, to the BS/MSC 106 over the U_m interface. The RLP protocol 212 is defined in IS-707.2, entitled "Data Service Options for Wideband Spread Spectrum Systems: Radio Link Protocol", February 1998, herein incorporated by reference, and the IS-95 protocol is defined in IS-95 mentioned above. A complementary RLP protocol 216 and IS-95 protocol 218 in the BS/MSC 106 pass the packets to the relay layer protocol 220 for transmission across the L interface to relay layer protocol 228. PPP_U protocol 226 then unframes the received packets and passes them to the network layer protocols 225, which will either pass them to upper layer protocols 221 or forward them on to the Internet.

As described in RFC 1661, the LCP Packets comprise a Configure-Request, a Configure-Ack, a Configure-Nak, and a Configure-Reject. The format of these packets is well known and described in RFC 1661.

The Configure-Request packet is used to negotiate configuration options. All configuration options are always negotiated simultaneously.

The Configuration-Ack packet is transmitted if every configuration option in a received Configuration-Request packet is recognizable and all values are acceptable.

The Configure-Nak packet is sent in response to a Configuration-Request packet when the requested configuration options are recognizable, but some of the values are not acceptable. The Options field of the Configure-Nak packet are filled only with the unacceptable configuration options from the Configure-

Request packet. Note that all configuration options are always Nak'd simultaneously.

The Configure-Reject packet is sent when a received Configure-Request includes configuration options that are unrecognizable or are not acceptable for negotiation. The options field of the Configure-Reject contains only the unacceptable configuration options from the Configure-Request.

The following comprises the well-known configuration options, described in RFC 1661, and defined for the PPP LCP protocol:

1. Maximum-Receive-Unit
2. Authentication-Protocol
3. Quality-Protocol
4. Magic-Number
5. Protocol-Field-Compression
6. Address-and-Control-Field-Compression
7. ASYNC – Control Character M_{RP}

Internet Protocol Control Protocol (IPCP) is a network control protocol responsible for configuring, enabling, and disabling Internet Protocol (IP) modules on both ends of the PPP link. IPCP is described in Request for Comment (RFC) 1332, "The PPP Internet Protocol Control Protocol (IPCP)", G. McGregor Merit, May, 1992, herein incorporated by reference. IPCP configuration options include:

1. IP-Addresses;
2. IP-Compression-Protocol; and
3. IP-Address

IPCP uses the same option negotiation mechanism as the Link Control Protocol (LCP).

LCP and IPCP Configuration option negotiations occur separately for both the R_m interface and the U_m interface. That is, LCP or IPCP configuration option negotiation over one of the R_m and U_m interfaces is separate from LCP or IPCP configuration option negotiation over the other of the R_m and U_m interfaces. Therefore, the wireless communication device (MT2) must

separately negotiate configuration options over the R_m and U_m interfaces. Separate configuration option negotiating by the MT2 over the R_m and the U_m interfaces causes the configuration option negotiation mechanism of the MT2 device to be unnecessarily complex and causes the configuration option negotiations on both interfaces to be unnecessarily long.

SUMMARY OF THE INVENTION

The present invention is a method and a wireless communication device (MT2) for simultaneously negotiating LCP or IPCP configuration options over both the R_m and the U_m interfaces.

When the MT2 device receives either an LCP or an IPCP Configure-Request packet over one of the R_m and the U_m interfaces, the MT2 device parses the requested configuration options and determines whether the requested options are supported by the MT2 device. If the requested options are supported, the MT2 device saves a Configure-Request ID, included in the Configure-Request packet, and frames the Configure-Request packet in a PPP frame for transmission on the other of the R_m and the U_m interfaces. If any of the requested configuration options are not supported by the MT2 device, the MT2 device creates a Configure-Reject packet, including the unsupported options, and frames the Configure-Reject packet in a PPP frame for transmission over the interface through which it received the Configure-Request packet, and the original request is discarded.

Thus, a simple and quick mechanism for simultaneously negotiatiating configuration options on both of the R_m and the U_m interfaces is provided.

BRIEF DESCRIPTION OF THE DRAWING

These and other advantages will become more apparent from the detailed description of the preferred embodiments along with the following drawings:

Fig. 1 illustrates a high-level block diagram of a wireless data communication device in which a terminal device connects to a network, such as the Internet, via a wireless communication device;

Fig. 2 is a diagram of the protocol stacks of each entity;

Fig. 3 is a flowchart showing the processing that occurs when the MT2 device receives a Configure-Request packet over the R_m interface;

Fig. 4 is a flowchart showing the processing that occurs when the MT2 device receives a Configuration-Ack packet over the R_m interface;

Fig. 5 is a flowchart showing the processing that occurs when the MT2 device receives a Configure-Request packet over the U_m interface; and

Fig. 6 is a flowchart showing the processing that occurs when the MT2 device receives a Configuration-Ack packet over the U_m interface.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As is known in the art, in order to establish communications over a point-to-point link, Link Control Protocol (LCP) packets for establishing, configuring and testing the data link connection must be exchanged over each PPP link, i.e., the R_m and U_m interfaces. Any options not negotiated use a predefined default value, as specified by RFC 1661.

Similarly, IPCP packets for negotiating and configuring IPCP configuration options must be exchanged over the R_m and U_m interfaces. Any options not negotiated use a predefined default value, as specified by RFC 1332.

As described in RFC 1661, the LCP Packets comprise a Configure-Request, a Configure-Ack, a Configure-Nak, and a Configure-Reject. The format of these packets is well known and described in RFC 1661.

Because the mechanism for negotiating IPCP configuration options is identical to the mechanism for negotiating LCP configuration options, the following detailed description applies to both LCP and IPCP.

In a conventional system, configuration option negotiations occur separately for both the R_m interface and the U_m interface. As described in RFC 1661 and RFC 1332, the Configure-Request packet contains a list of the options being requested and the Configuration-Ack packet contains a list of the options which the sender is acknowledging.

Fig. 3 explains the processing which occurs when a LCP or a IPCP Configure-Request packet is received by the MT2 device over the R_m interface. Step S310 is performed to parse the configuration options requested in the Configure-Request packet. In step S320, each of the options are checked to determine whether they are supported by the MT2 device.

If any of the options are not supported, step S330 is performed to create a Configure-Reject packet for the bad options. In step S340, the Configure-Request packet is discarded. In step S350, the Configure-Reject packet is sent to the PPP framer for the R_m interface, which will subsequently cause the Configure-Reject packet to be encapsulated in a PPP frame for transmission over the R_m interface.

If step S320 determines that all of the requested options are supported by the MT2 device, then step S360 is performed to save a Configure-Request ID, included in the Configure-Request packet. Step S370 is then performed to pass the Configure-Request packet to the PPP framer for encapsulation in a PPP frame for transmission over the U_m interface.

Fig. 4 explains the processing which occurs when a Configuration-Ack packet is received by the MT2 device over the R_m interface. In step S410, an ID in the Configuration-Ack packet is compared to the Configure-Request ID. If the IDs match, then step S420 is performed to save the configuration options included in the Configuration-Ack packet. Step S430 is performed to pass the Configuration-Ack packet to the PPP framer for the U_m interface, which will subsequently cause the Configuration-Ack packet to be encapsulated in a PPP frame and transmitted over the U_m interface.

If step S410 determines that the ID in the Configuration-Ack packet does not match the Configure-Request ID, then step S430 is performed to pass the

Configuration-Ack packet to the PPP framer for the U_m interface, which will subsequently cause the Configuration-Ack packet to be encapsulated in a PPP frame and transmitted over the U_m interface. In other words, the configuration options are not saved when the ID in the Configuration-Ack packet does not match the Configure-Request ID.

Fig. 5 shows the processing that is performed when a Configure-Request packet is received over the U_m interface. Figure 5 is analogous to Fig. 3, which shows the processing which occurs when a Configure-Request packet is received over the R_m interface. Step S510 is performed to parse the configuration options requested in the Configure-Request packet. In step S520, each of the options is checked to determine whether it is supported by the MT2 device.

If any of the options are not supported, step S530 is performed to create a Configure-Reject packet for the bad options. In step S540, the Configure-Request packet is discarded. In step S550, the Configure-Reject packet is sent to the PPP framer for the R_m interface, which will encapsulate the packet in a PPP frame for transmission on the R_m interface.

If step S520 determines that all of the requested options are supported by the MT2 device, then step S560 is performed to save a Configure-Request ID, included in the Configure-Request packet. Step S570 is then performed to pass the Configure-Request packet to the PPP framer for the U_m interface, which encapsulates the packet in a PPP frame for transmission over the U_m interface.

Fig. 6 shows the processing which occurs when a Configuration-Ack packet is received over the U_m interface. Fig. 6 is analogous to Fig. 4 which shows the processing which occurs when a Configuration-Ack packet is received over the R_m interface. In step S610, an ID in the Configuration-Ack packet is compared to the Configure-Request ID. If the IDs match, then step S620 is performed to save the configuration options included in the Configuration-Ack packet. Step S630 is performed to pass the Configuration-Ack packet to the PPP framer for the U_m interface, which will subsequently

cause the Configuration-Ack packet to be encapsulated in a PPP frame and transmitted over the R_m interface.

If step S610 determines that the ID in the Configuration-Ack packet does not match theConfigure-Request ID, then step S630 is performed to pass the Configuration-Ack packet to the PPP framer for the R_m interface, which will subsequently cause the Configuration-Ack packet to be encapsulated in a PPP frame and transmitted over the R_m interface. In other words, the configuration options are not saved when the ID in the Configuration-Ack packet does not match the Configure-Request ID.

Any other configuration negotiation packets received on one of the R_m and the U_m interfaces will be passed through the MT2 device and transmitted on the other of the R_m and the U_m interfaces.

Fig. 7 shows examples of LCP configuration negotiations. At 70, the TE2 device sends a LCP Configure-Request packet over the R_m interface to the MT2 device. At 72, the MT2 receives the LCP Configure-Request packet, determines that the MT2 device does not support all the requested configuration options of the LCP Configure-Request packet and generates and sends a LCP Configure-Reject packet, indicating the bad options, over the R_m interface.

At 74, the TE2 generates a LCP Configure-Request packet over the R_m interface. At 76, the MT2 device receives the LCP Configure-Request packet, parses the configuration options, determines that the configuration options are supported by the MT2 device, saves the Configure-Request ID from the LCP Configure-Request packet, frames the LCP Configure-Request packet in a PPP frame and transmits the PPP frame over the U_m interface. At 78, the IWF analyzes the LCP Configure-Request packet, determines that some of the requested options are bad, and sends a LCP Configure-Reject packet, including the bad options to the MT2 device over the U_m interface. At 80, the MT2 device receives the LCP Configure-Reject packet, determines that the received packet is neither a LCP Configure-Request packet nor a LCP Configuration-Ack packet and the MT2 device transmits the LCP Configure-Reject packet over the R_m interface to the TE2 device.

At 82, the TE2 device generates a LCP Configure Request packet over the R_m interface to the MT2 device. At 84, the MT2 device parses the configuration options included in the LCP Configure-Request packet, determines that the MT2 device supports all configuration options, encapsulates the LCP Configure-Request packet in a PPP frame, and transmits the PPP frame over the U_m interface to the IWF. At 86, the IWF determines that it would prefer to negotiate other values of the requested options and the IWF generates and transmits a LCP Configure-Nak packet indicating the desired option values. At 88, the MT2 receives the LCP Configure-Nak, determines that the received packet is neither a LCP Configure-Request packet nor a LCP Configuration-Ack packet and the MT2 device transmits the LCP Configure-Nak, encapsulated in a PPP frame, over the R_m interface to the TE2 device.

The above examples of Fig. 7 use the PPP LCP protocol, however, the IPCP protocol may also be used because the configuration negotiation mechanism is identical to the LCP protocol. For example, a IPCP Configure-Request may be used in place of a LCP Configure-Request; a IPCP Configure-Reject may be used in place of a LCP Configure-Reject; a IPCP Configure-Nak may be used in place of a LCP Configure-Nak, ..., etc.

One of ordinary skill in the art would also understand that any of the above mentioned LCP or IPCP configuration negotiation packets may be transmitted from either the R_m interface or the U_m interface.

While this invention has been described in connection with what is presently considered to be the preferred embodiment, it is to be understood that the invention is not limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

We claim as our invention:

CLAIMS

1. A method of simultaneously establishing a PPP link between a wireless communication device and an interworking function (IWF) on a U_m interface, and between said wireless communication device and a TE2 device over a R_m interface, said method comprising:

receiving, in said wireless communication device, a Configure-Request packet over said R_m interface;

determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

creating and sending a Configure-Reject packet when said determining determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device; and

framing said Configure-Request packet in a PPP frame and transmitting said PPP frame over said U_m interface, when said determining determines that all of said configuration options in said Configuration Request packet are supported.

2. A method according to claim 1, further comprising:

storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining determines that all of said configuration options in said Configure-Request packet are supported.

3. A method according to claim 1, further comprising:

receiving a Configuration-Ack packet over said U_m interface; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said R_m interface.

4. A method according to claim 2, further comprising:

receiving a Configuration-Ack packet over said R_m interface; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said U_m interface.

5. A method according to claim 4, further comprising:

determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory.

6. A method of simultaneously establishing a PPP link between a wireless communication device and an interworking function (IWF) on a U_m interface, and between said wireless communication device and a TE2 device over a R_m interface, said method comprising:

receiving, in said wireless communication device, a Configure-Request packet over said R_m interface;

determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

creating and sending a Configure-Reject packet when said determining determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device;

storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining determines that all of said configuration options in said Configure-Request packet are supported;

framing said Configure-Request packet in a PPP frame and transmitting said PPP frame over said U_m interface, when said determining determines that

all of said configuration options in said Configuration Request packet are supported;

receiving a Configuration-Ack packet over said U_m interface;

determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory;

saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said R_m interface.

7. A method of simultaneously establishing a PPP link between a wireless communication device and an interworking function (IWC) on a U_m interface, and between said wireless communication device and a TE2 device over a R_m interface, said method comprising:

receiving, in said wireless communication device, a Configure-Request packet over said U_m interface;

determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

creating and sending a Configure-Reject packet when said determining determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device; and

framing said Configure-Request packet in a PPP frame and transmitting said PPP frame over said R_m interface, when said determining determines that all of said configuration options in said Configuration Request packet are supported.

8. A method according to claim 7, further comprising:

storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining determines that all of said configuration options in said Configure-Request packet are supported.

9. A method according to claim 8, further comprising:

receiving a Configuration-Ack packet over said R_m interface; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said U_m interface.

10. A method according to claim 8, further comprising:

receiving a Configuration-Ack packet over said R_m interface; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said U_m interface.

11. A method according to claim 10, further comprising:

determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID; and

saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory.

12. A method of simultaneously establishing a PPP link between a wireless communication device and an interworking function (IWC) on a U_m interface, and between said wireless communication device and a TE2 device over a R_m interface, said method comprising:

receiving, in said wireless communication device, a Configure-Request packet over said U_m interface;

determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

creating and sending a Configure-Reject packet when said determining determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device;

storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining determines that all of said configuration options in said Configure-Request packet are supported;

framing said Configure-Request packet in a PPP frame and transmitting said PPP frame over said R_m interface, when said determining determines that all of said configuration options in said Configuration Request packet are supported;

receiving a Configuration-Ack packet over said R_m interface;

determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory;

saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

framing said Configuration-Ack packet in said PPP frame and sending said PPP frame including said Configuration-Ack packet over said U_m interface.

13. A wireless communication device capable of simultaneously establishing a PPP link to an interworking function (IWC) on a U_m interface, and to a TE2 device over a R_m interface, said wireless communication device comprising:

means for receiving a Configure-Request packet over said R_m interface;

means for determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

means for creating and for sending a Configure-Reject packet when said determining means determines that at least one of said configuration options

included in said Configure-Request packet is not supported by said wireless communication device; and

means for framing said Configure-Request packet in a PPP frame and for transmitting said PPP frame over said U_m interface, when said determining means determines that all of said configuration options in said Configuration Request packet are supported.

14. A wireless communication device according to claim 13, further comprising:

means for storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining means determines that all of said configuration options in said Configure-Request packet are supported.

15. A wireless communication device according to claim 13, further comprising:

means for receiving a Configuration-Ack packet over said U_m interface; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said R_m interface.

16. A wireless communication device according to claim 15, further comprising:

means for receiving a Configuration-Ack packet over said U_m interface; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said R_m interface.

17. A wireless communication device according to claim 16, further comprising:

means for determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

means for saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory.

18. A wireless communication device capable of simultaneously establishing a PPP link to an interworking function (IWC) on a U_m interface, and to a TE2 device over a R_m interface, said wireless communication device comprising:

means for receiving a Configure-Request packet over said R_m interface;

means for determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

means for creating and for sending a Configure-Reject packet when said determining means determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device;

means for storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining means determines that all of said configuration options in said Configure-Request packet are supported;

means for framing said Configure-Request packet in a PPP frame and for transmitting said PPP frame over said U_m interface, when said determining means determines that all of said configuration options in said Configuration Request packet are supported;

means for receiving a Configuration-Ack packet over said U_m interface;

means for determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory;

means for saving values of all options included in said Configuration-Ack packet when said determining determines that said ID in said

Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said R_m interface.

19. A wireless communication device capable of simultaneously establishing a PPP link an interworking function (IWC) on a U_m interface, and to a TE2 device over a R_m interface, said wireless communication device comprising:

means for receiving a Configure-Request packet over said U_m interface;

means for determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

means for creating and for sending a Configure-Reject packet when said determining means determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device; and

means for framing said Configure-Request packet in a PPP frame and for transmitting said PPP frame over said R_m interface, when said determining determines that all of said configuration options in said Configuration Request packet are supported.

20. A wireless communication device according to claim 19, further comprising:

means for storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining means determines that all of said configuration options in said Configure-Request packet are supported.

21. A wireless communication device according to claim 20, further comprising:

means for receiving a Configuration-Ack packet over said R_m interface; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said U_m interface.

22. A wireless communication device according to claim 20, further comprising:

means for receiving a Configuration-Ack packet over said U_m interface; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said R_m interface.

23. A wireless communication device according to claim 22, further comprising:

means for determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

means for saving values of all options included in said Configuration-Ack packet when said determining means determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory.

24. A wireless communication device capable of simultaneously establishing a PPP link to an interworking function (IWC) on a U_m interface, and to a TE2 device over a R_m interface, said wireless communication device comprising:

means for receiving a Configure-Request packet over said U_m interface;

means for determining whether all configuration options included in said Configure-Request packet are supported by said wireless communication device;

means for creating and for sending a Configure-Reject packet when said determining means determines that at least one of said configuration options included in said Configure-Request packet is not supported by said wireless communication device;

means for storing, in a memory, a Configure-Request ID, included in said Configure-Request packet, when said determining means determines that all of said configuration options in said Configure-Request packet are supported;

means for framing said Configure-Request packet in a PPP frame and for transmitting said PPP frame over said R_m interface, when said determining means determines that all of said configuration options in said Configuration Request packet are supported;

means for receiving a Configuration-Ack packet over said R_m interface;

means for determining whether an ID included in said Configuration-Ack packet matches said Configure-Request ID stored in said memory;

means for saving values of all options included in said Configuration-Ack packet when said determining means determines that said ID in said Configuration-Ack packet matches said Configure-Request ID stored in said memory; and

means for framing said Configuration-Ack packet in said PPP frame and for sending said PPP frame including said Configuration-Ack packet over said U_m interface.

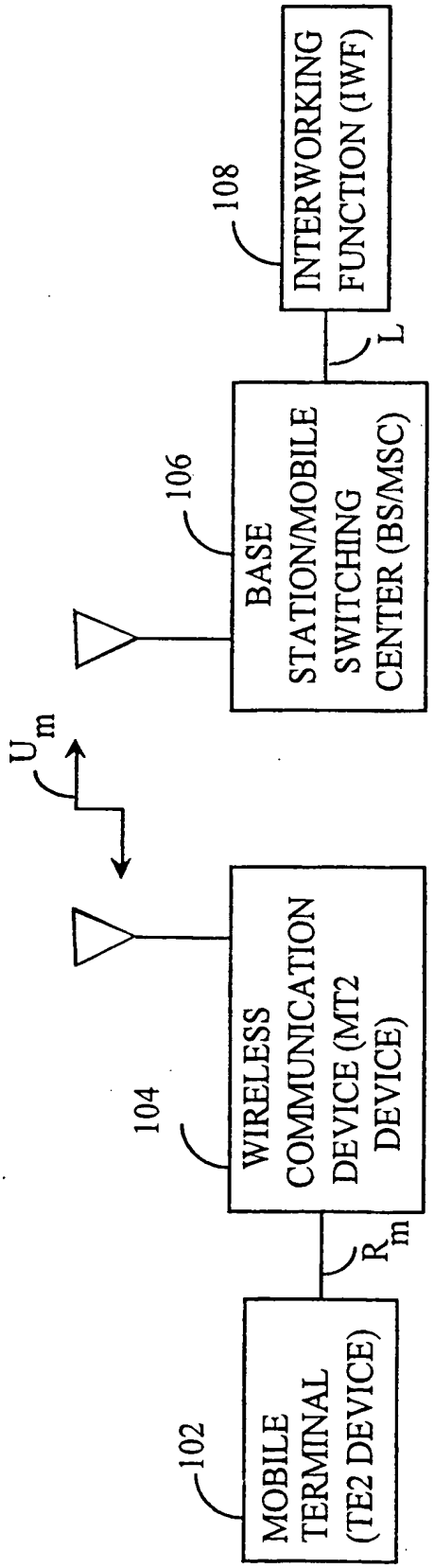

MOBILE TERMINAL (TE2 DEVICE)
102
R_m
WIRELESS COMMUNICATION DEVICE (MT2 DEVICE)
104
U_m
BASE STATION/MOBILE SWITCHING CENTER (BS/MSC)
106
L
INTERWORKING FUNCTION (IWF)
108

FIG. 1

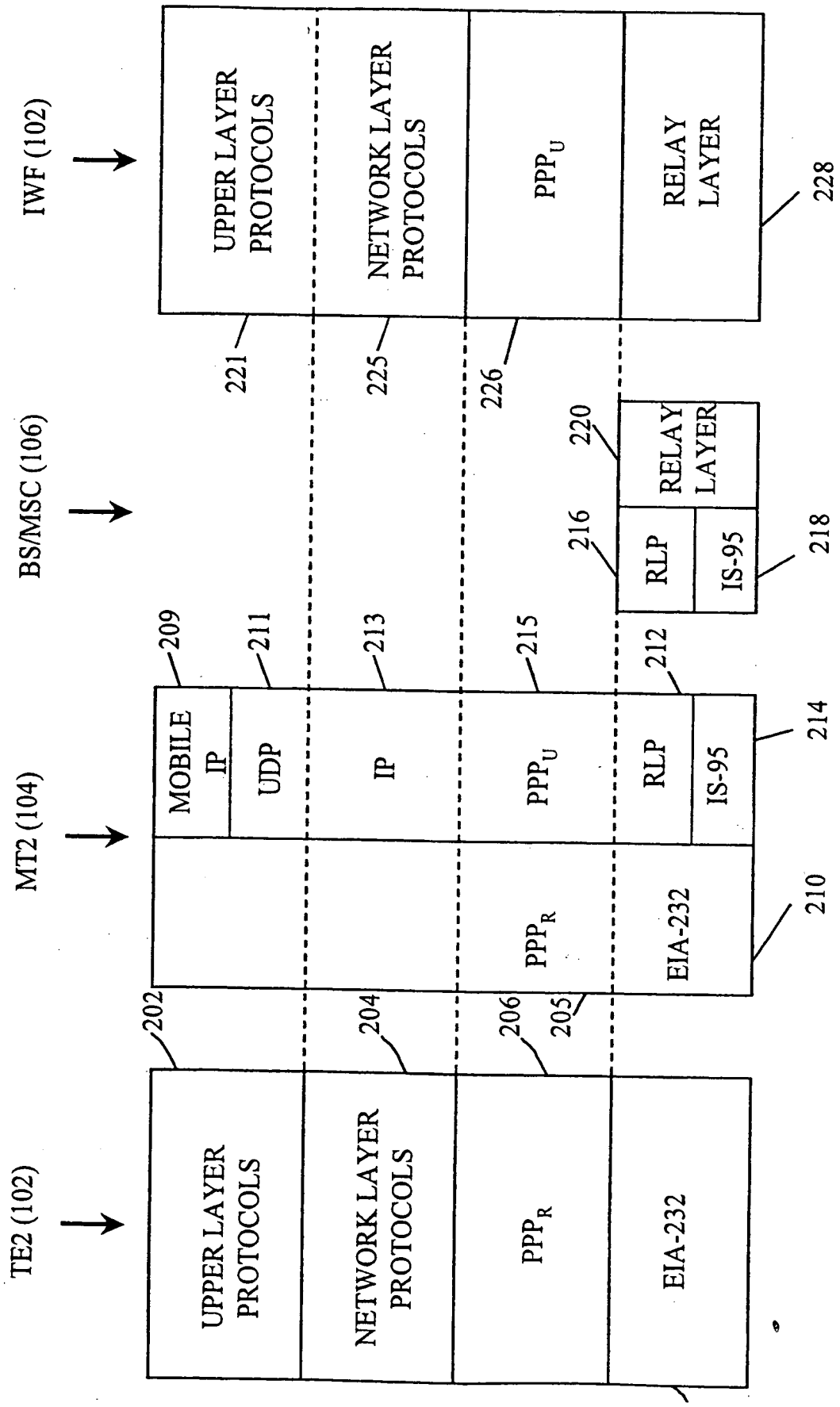

IWF (102)
BS/MSC (106)
MT2 (104)
TE2 (102)
UPPER LAYER PROTOCOLS
NETWORK LAYER PROTOCOLS
PPP$_U$
RELAY LAYER
MOBILE IP
UDP
IP
PPP$_U$
RLP
IS-95
RLP
RELAY LAYER
IS-95
PPP$_R$
EIA-232
UPPER LAYER PROTOCOLS
NETWORK LAYER PROTOCOLS
PPP$_R$
EIA-232
202
204
206
205
209
211
213
215
212
214
216
218
220
221
225
226
228
210

FIG. 2

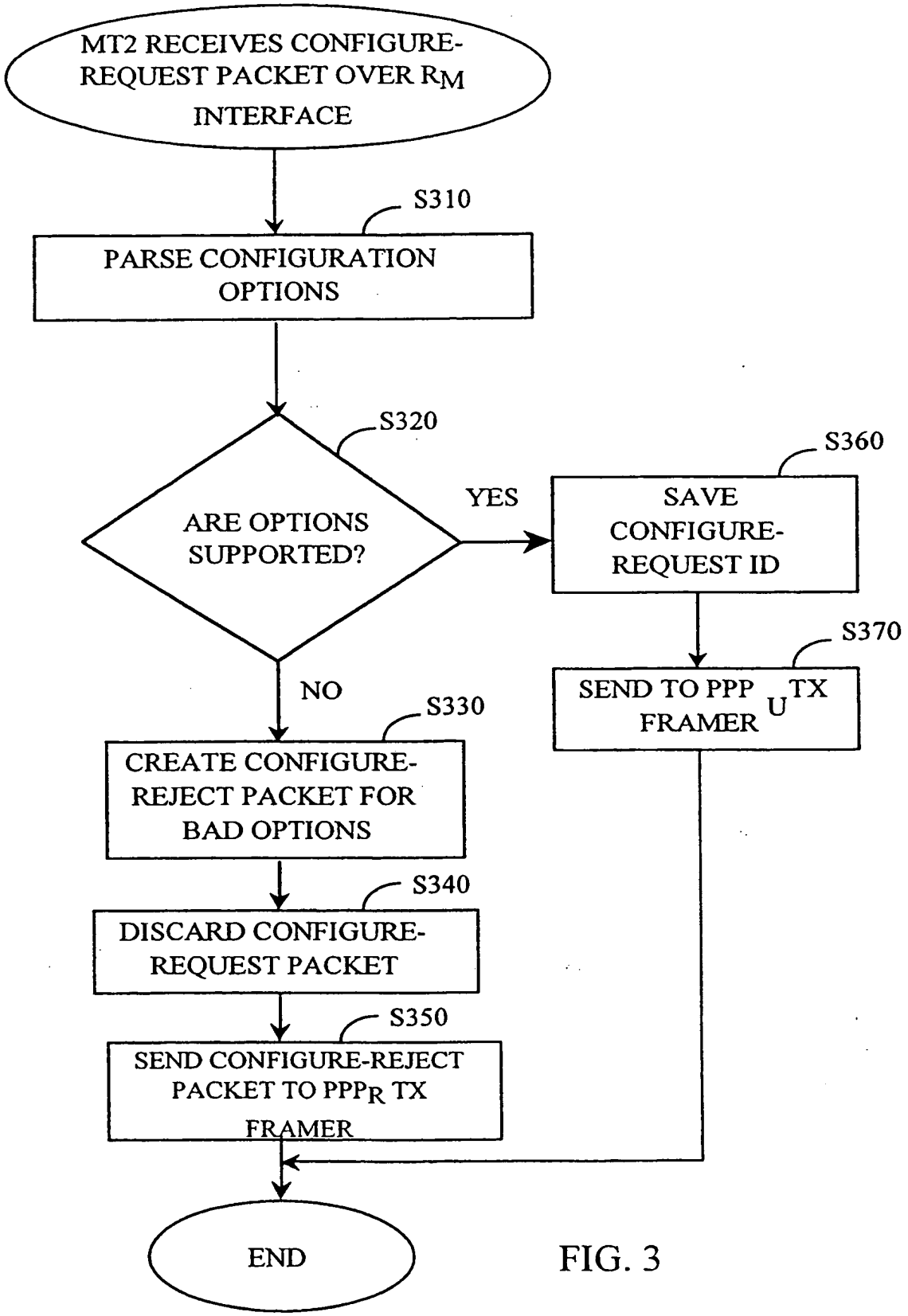

MT2 RECEIVES CONFIGURE-REQUEST PACKET OVER R_M INTERFACE
S310
PARSE CONFIGURATION OPTIONS
S320
ARE OPTIONS SUPPORTED?
YES
S360
SAVE CONFIGURE-REQUEST ID
S370
SEND TO PPP $_U$ TX FRAMER
NO
S330
CREATE CONFIGURE-REJECT PACKET FOR BAD OPTIONS
S340
DISCARD CONFIGURE-REQUEST PACKET
S350
SEND CONFIGURE-REJECT PACKET TO PPP$_R$ TX FRAMER
END

FIG. 3

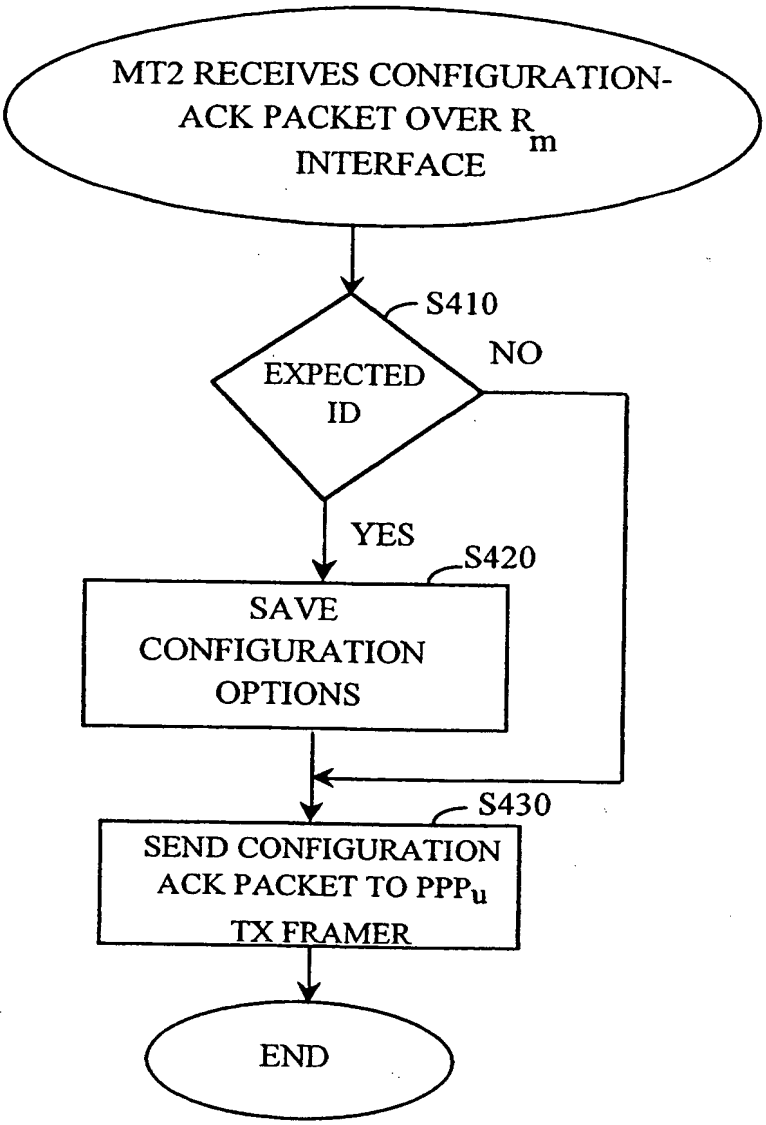

MT2 RECEIVES CONFIGURATION-ACK PACKET OVER R_m INTERFACE
S410
EXPECTED ID
NO
YES
S420
SAVE CONFIGURATION OPTIONS
S430
SEND CONFIGURATION ACK PACKET TO PPP_u TX FRAMER
END

FIG. 4

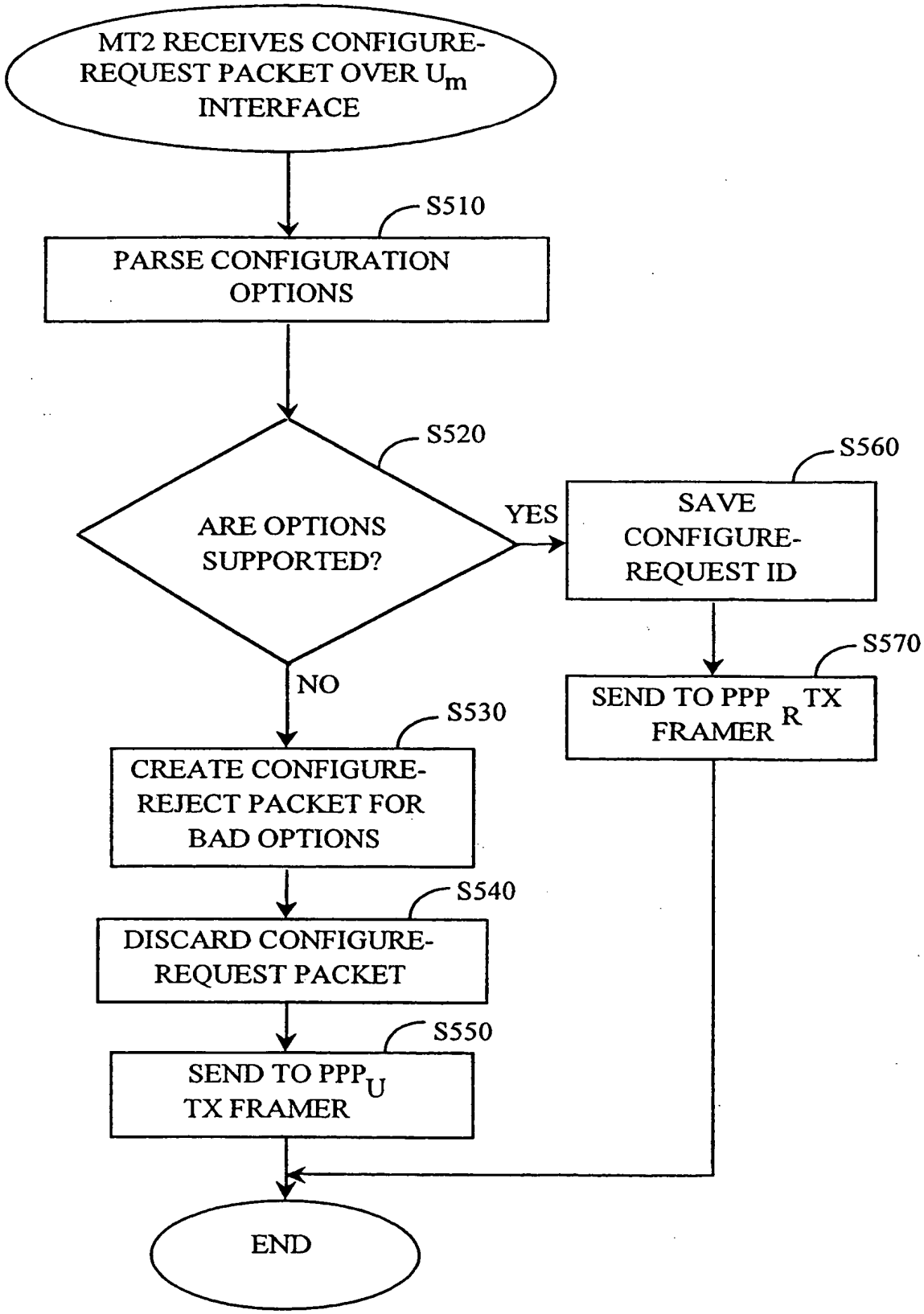

MT2 RECEIVES CONFIGURE-REQUEST PACKET OVER U_m INTERFACE
S510
PARSE CONFIGURATION OPTIONS
S520
ARE OPTIONS SUPPORTED?
YES
S560
SAVE CONFIGURE-REQUEST ID
S570
SEND TO PPP $_R$ TX FRAMER
NO
S530
CREATE CONFIGURE-REJECT PACKET FOR BAD OPTIONS
S540
DISCARD CONFIGURE-REQUEST PACKET
S550
SEND TO PPP $_U$ TX FRAMER
END

FIG. 5

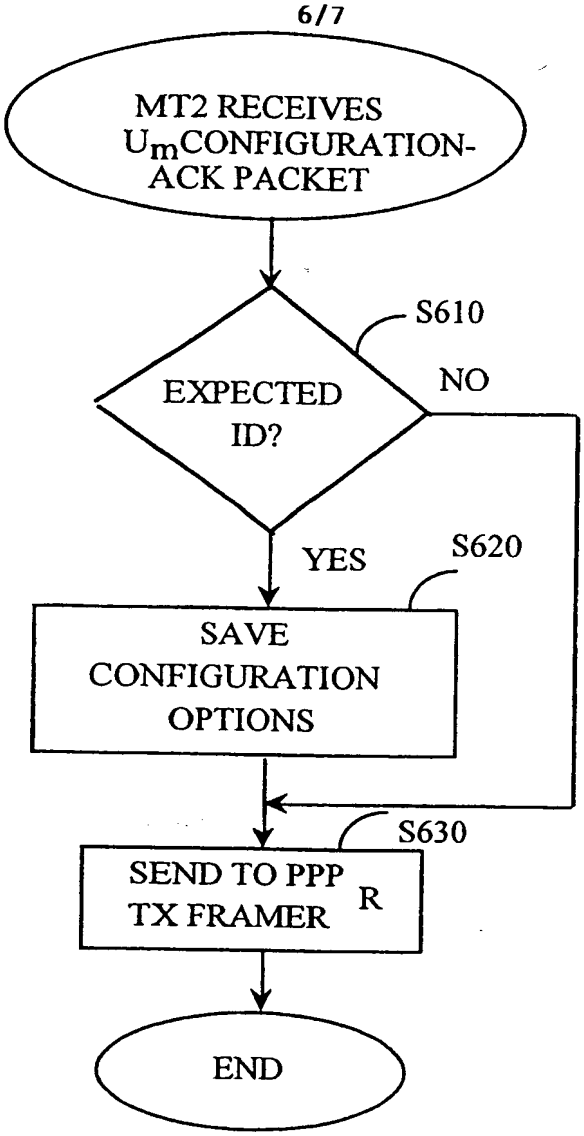

MT2 RECEIVES U_mCONFIGURATION-ACK PACKET
S610
EXPECTED ID?
NO
YES
S620
SAVE CONFIGURATION OPTIONS
S630
SEND TO PPP TX FRAMER
R
END

FIG. 6

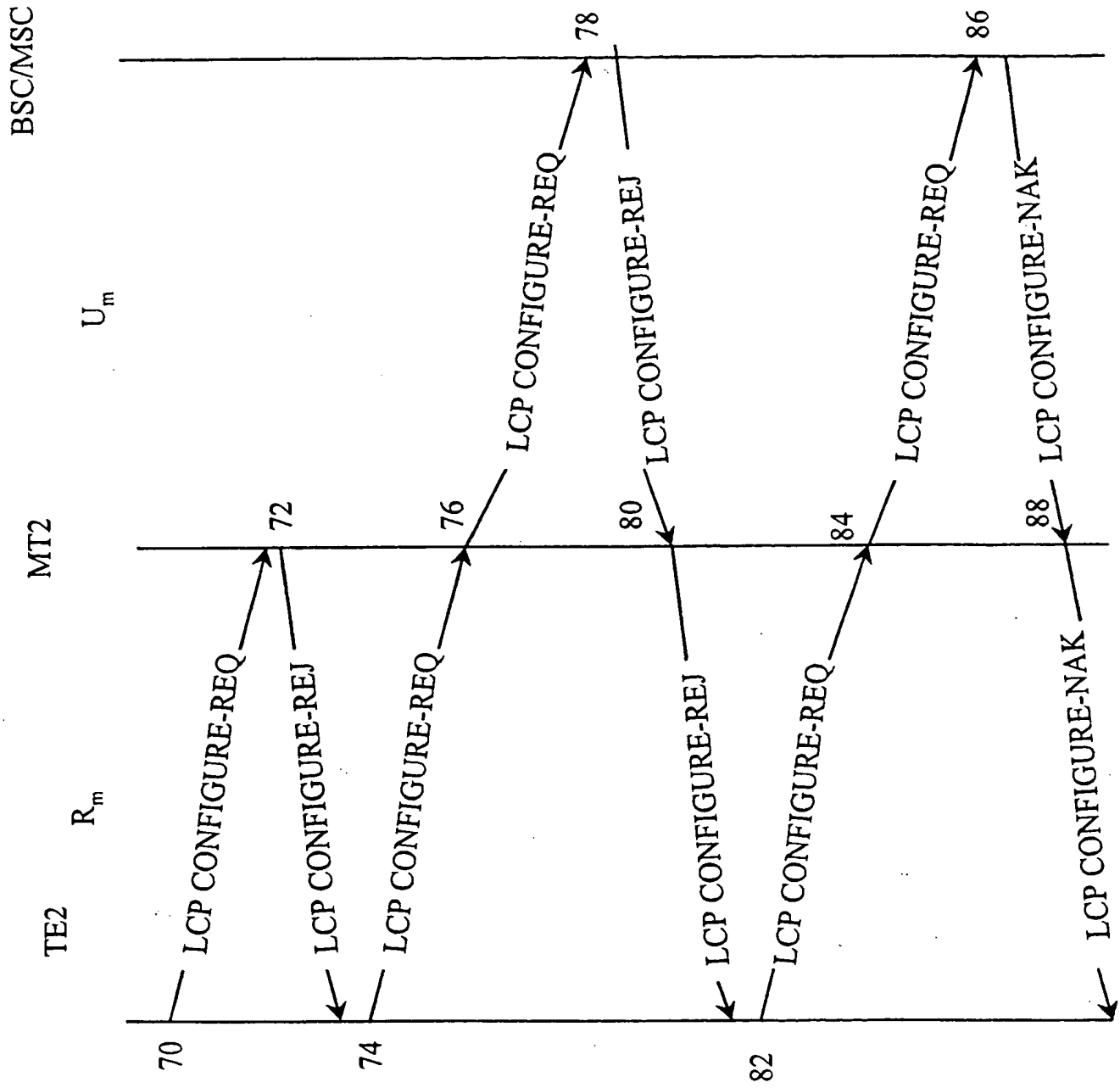


FIG. 7

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/US 00/04931

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/08 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, PAJ, IBM-TDB, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 05726 A (3COM CORP) 13 February 1997 (1997-02-13) abstract page 10, line 17 - line 38 figure 5 ---	1-24
A	W. SIMPSON: "RFC 1661: The Point-to-Point Protocol (PPP)" NETWORK WORKING GROUP. REQUEST FOR COMMENTS., 31 - 31 July 1994, pages 26-32, XP002141548 cited in the application the whole document ---	1-24
A	US 5 708 655 A (HALL GOERAN ET AL) 13 January 1998 (1998-01-13) column 8, line 22 - line 31 --- -/--	1-24

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2000	13/07/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Blanco Cardona, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 00/04931

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
P,A	EP 0 910 198 A (LUCENT TECHNOLOGIES INC) 21 April 1999 (1999-04-21) column 14, paragraph 32 -column 15, paragraph 33 column 16, paragraph 38 - paragraph 41 column 30, paragraph 90 figures 13,17,25	1-24

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ional Application No
PCT/US 00/04931

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9705726 A	13-02-1997	US 5666362 A	09-09-1997
		EP 0873625 A	28-10-1998
US 5708655 A	13-01-1998	AU 718114 B	06-04-2000
		AU 3199797 A	07-01-1998
		BR 9709572 A	10-08-1999
		CA 2257981 A	18-12-1997
		CN 1228228 A	08-09-1999
		EP 0904665 A	31-03-1999
		WO 9748246 A	18-12-1997
EP 0910198 A	21-04-1999	CA 2249817 A	14-04-1999
		CA 2249830 A	14-04-1999
		CA 2249831 A	14-04-1999
		CA 2249836 A	14-04-1999
		CA 2249837 A	14-04-1999
		CA 2249838 A	14-04-1999
		CA 2249839 A	14-04-1999
		CA 2249862 A	14-04-1999
		CA 2249863 A	14-04-1999
		EP 0912026 A	28-04-1999
		EP 0917320 A	19-05-1999
		EP 0917318 A	19-05-1999
		EP 0912027 A	28-04-1999
		EP 0912012 A	28-04-1999
		EP 0917328 A	19-05-1999
		EP 0918417 A	26-05-1999
		EP 0912017 A	28-04-1999
		JP 11289353 A	19-10-1999
		JP 11252183 A	17-09-1999
		JP 11275154 A	08-10-1999
		JP 11275155 A	08-10-1999
		JP 2000022758 A	21-01-2000
		JP 11275156 A	08-10-1999
		JP 11275157 A	08-10-1999
		JP 11284666 A	15-10-1999
		JP 11331276 A	30-11-1999